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ABSTRACT

This study gathered information about the impact of mathematics courses designed for paraeducators enrolled in an Urban Preservice Degree Articulation in Teacher Education (UPDATE) program. The goal was for paraeducators to complete mathematics courses with a passing grade, to experience mathematics content using constructivist instructional approaches, and to improve their attitudes toward mathematics. During summer 1998, 22 UPDATE scholars enrolled in Algebra I, a precollege developmental mathematics course. After successfully completing this course, 21 of the paraeducators enrolled in Algebra II, another developmental course. During Fall 1998, 16 of the paraeducators who completed Algebra II enrolled in their first college-level mathematics course, Math for Early Childhood/Elementary Teachers. Researchers administered an attitudinal survey and an instructional strategy survey. Pre and post scores on the attitudinal survey were analyzed for any significant change in paraeducators' attitudes toward mathematics. The instructional survey was administered at the end of the course to collect information about teaching methods used and to learn how these methods impacted learning. A focus group suggested that the use of manipulatives, hands-on activities, and cooperative learning groups helped UPDATE scholars learn mathematics. The surveys suggested that the mathematics courses improved paraeducators' attitudes toward mathematics. All paraeducators received a grade of C or better in the three math courses. (Contains 16 references.) (Author/SM)

The Impact of an Innovative User-Friendly Mathematics Program on Preservice Teachers' Attitudes Toward Mathematics

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Abstract

The purpose of this study was to gather information about the impact, if any, of mathematics courses designed for paraeducators enrolled in an Urban Preservice Degree Articulation in Teacher Education (UPDATE) Program. The goal was for paraeducators to complete mathematics courses with a passing grade, to experience mathematics content using constructivist instructional approaches, and to improve their attitudes toward mathematics. During Summer 1998, twenty-two UPDATE Scholars enrolled in Algebra I, a pre-college developmental mathematics course. After successfully completing this course twenty-one of these paraeducators enrolled in Algebra II, another pre-college developmental mathematics course. During Fall 1998, sixteen of the paraeducators who completed Algebra II enrolled in their first college-level mathematics course, Math for Early Childhood/Elementary Teachers. Two quantitative surveys, an Attitudinal Survey and an Instructional Strategy Survey, were administered. Pre and post scores on the Attitudinal Survey were analyzed for any significant change in paraeducators' attitudes toward mathematics. The Instructional Survey was administered at the end of the course to collect information about the teaching methods used and to learn how these methods impacted learning. A focus group suggested that the use of manipulatives, hands-on activities, and cooperative learning groups helped UPDATE Scholars learn mathematics. The surveys suggested that the mathematics courses improved paraeducators' attitudes toward mathematics. Additionally, all paraeducators received a grade of C or better in the above three mathematics courses. These findings provide evidence that a user-friendly mathematics program had a positive impact on UPDATE Scholars' attitudes toward mathematics.

The Impact of an Innovative User-Friendly Mathematics Program on Preservice Teachers' Attitude Toward Mathematics

The purpose of this study was to gather information about the impact of an innovative user-friendly mathematics program designed for paraeducators enrolled in an Urban Preservice Degree Articulation in Teacher Education (UPDATE) Program. The primary goal was for paraeducators to experience mathematics content using constructivist instructional approaches in the hope that this would improve their attitudes toward mathematics. Many researchers have suggested that teachers' attitudes and beliefs about mathematics have a great impact on how they teach mathematics (Ball, 1990a, 1990b; Moreiri, 1991; Peterson, Fennema, Carpenter & Loef 1989; Schoenfeld, 1985, 1989; & Silver, 1985). In addition, Cipra & Flanders (1992) have documented the need to improve the mathematical preparation of pre-service elementary school teachers in their report: On the Mathematical Preparation of Elementary School Teachers. Furthermore, changes in K-12 level mathematics instruction require reform within college level mathematics and education classes that teacher candidates take throughout their teacher preparation programs (NSF, 1993). Modeling reform-style teaching for preservice teachers is important because research in teacher education has shown that teachers tend to teach the way they have been taught (Brown & Borko, 1992; Kennedy, 1991).

The National Council of Teachers of Mathematics (NCTM, 1989; 1991; 1995) and the Mathematical Association of America [MAA] (Tucker & Leitzel, 1995) promote instructional strategies which utilize cooperative group work, the use of manipulatives and hands-on learning experiences, and problem solving that is related to the everyday life of students. Mathematics education is in the midst of reform that is based on the philosophy that students are active learners who construct their own mathematical knowledge. If we want public school

teachers to engage students in their own learning, using constructivist instructional strategies, then we need college professors to model these effective strategies in their own teaching (NRC, 1991).

The issue of how to enhance preservice teachers' attitudes toward mathematics is of considerable interest to the field of mathematics education. In order to better understand the impact of constructivist instructional approaches used in mathematics courses, we examined paraeducators' attitudes toward mathematics and changes in their attitudes as a result of their experiences in a user-friendly mathematics program.

Background

Students enrolled in urban schools are comprised of diverse socioeconomic, linguistic and ethnic backgrounds; however few teacher training programs address the need to recruit and train teachers that reflect this diversity. Project UPDATE a collaborative between Springfield Technical Community College (STCC), the University of Massachusetts-Amherst School of Education, the University of Massachusetts/University Without Walls and the Springfield Public Schools was designed to address several key issues: the need for a higher proportional representation of teachers of color in an urban school, the need to develop teachers who possess solid general education competency, and the need to develop teachers who are multiculturally sensitive, technologically competent and able to help children in urban schools to cope with the complex social issues facing them. Preliminary research revealed that many paraeducators in the Springfield public schools were people of color who were interested in becoming teachers.

The UPDATE preservice teacher education program uses a multicultural learning community approach, exposing paraeducators to a range of teaching methods as they complete their course work and establishes a solid foundation upon which successful post-secondary educational experiences can be developed. The mission of the collaborative was to increase diversity and

better prepare paraeducators to fill teaching vacancies in the urban schools of Springfield.

Program Overview

The UPDATE program is supported through a three-year grant from the Fund to Improve Postsecondary Education (FIPSE). The grant supports the development and piloting of an Associate of Arts to Bachelor of Arts teacher education curriculum that is designed to meet the educational challenges of urban school systems. A major project goal was to pilot improved methodologies for delivery of multiculturally rich, technologically relevant courses to adult learners (paraeducators in Springfield City Schools) who were already immersed in urban public educational issues and who desired to become certified to teach. UPDATE recognizes urban school systems as major employers struggling to hire a "new breed" of teachers prepared to meet the social and technological challenges inherent in the urban classroom of the year 2000 and beyond. It provides access, support, a new preservice curriculum, and an alternative model.

UPDATE Scholars continue to work full time as paraeducators while attending college part time. Individuals with little or no experience begin at STCC and work toward an Associate of Arts degree. Upon completion of their Associate of Arts degree, UPDATE Scholars continue to work toward their Bachelor of Arts degree from the University of Massachusetts through the UMass University Without Walls (UWW) program. Paraeducators who already have a significant amount of college experience go directly into the UWW program. Through UWW, students may acquire credit for experiential learning. UPDATE Scholars also acquire a Teaching Certificate (Early Childhood or Elementary) through the University of Massachusetts School of Education. All courses are offered in Springfield at STCC. UPDATE Scholars are eligible for federal and state financial aid.

STCC successfully leveraged additional funds to support the UPDATE program. Resources from the Eisenhower Professional Development program were secured: 1) to help support pre-enrollment coordination; 2) to revise existing courses to include integrated academics, the Commonwealth of Massachusetts Department of Education Curriculum Frameworks, and applied learning theory; 3) to support students' hands-on exposure to technology as an integral part of the liberal arts and sciences design; 4) to increase UPDATE Scholar's English language proficiency through ESL and pre-college literacy programs; and 5) to enhance learning in mathematics, science, and technology through readiness activities.

Eisenhower initiatives have included the redesign of STCC's Education Transfer Option courses. Redesign initiatives included:

- A curriculum enhanced with technology.
- Course content, which emphasizes the rich cultural and racial diversity, reflected in today's society.
- General Education courses delivered in a constructivist mode. Learning that is student-active oriented, inquiry-based, and collaborative (the use of multiple strategies to engage students with different learning styles and honor a range of abilities).
- Infusion of the Massachusetts Curriculum Frameworks, as appropriate, into liberal arts and science courses.
- Development and designation of learner outcomes and competencies.

Mathematics Courses

Paraeducators enrolled in Project UPDATE are required to take a placement test to identify their mathematics skills. During Summer 1998 two pre-college level mathematics courses (Algebra I and Algebra II) were offered to paraeducators who tested very low on the College's basic skills placement test. (The overall goal of the two developmental mathematics courses was to prepare participants for college level mathematics work.) In addition, a college

level mathematics course was offered to eight UPDATE Scholars whose placement test scores indicated they were ready for college level work.

Three mathematics courses were offered at STCC during Summer 1998 (Elementary Algebra I, Elementary Algebra II, and Math for Early Childhood/Elementary Teachers, a college level mathematics content course). In addition, Math for Early Childhood/Elementary Teachers was offered during Fall 1998. All three mathematics courses were taught using a wide range of instructional strategies (e.g. collaborative group work, problem solving, the use of manipulatives, and calculators).

Elementary Algebra I and II topics included: integer operations, operations on polynomials, solving problems, properties of real numbers, applications, graphing, systems of equations and their applications, factoring, operations with rational expressions, operations with exponents, scientific notation, and solving quadratic equations. Math for Early Childhood/Elementary Teachers topics included: the application of problem solving techniques to elementary concepts such as sets, inequalities, non-decimal systems, and a survey of the properties and operations of the number system from natural to real numbers. Overall, all three mathematics courses spent a large proportion of class time working in groups discussing how to solve problems. The instructors broke down mathematical concepts into the smallest, simplest pieces.

Twenty-two UPDATE Scholars enrolled and completed Algebra I (MM 087) in the first session of classes during Summer 1998. After completing Algebra I, twenty-one of these students enrolled and completed Algebra II (MM 097) in the second session of classes during Summer 1998. One student could not take the second mathematics course during the second summer session due to family responsibilities; however, she plans to take the course the next time that it is offered. During Fall 1998 sixteen of the paraeducators who completed Algebra II enrolled and completed Math for Early Childhood/ Elementary

Teachers. All UPDATE Scholars enrolled in the above mathematics courses passed with a grade of C or better.

Participants

As of January 1999, 52 paraeducators were formally enrolled in the UPDATE program: 45 were lower-division undergraduates matriculating in the Springfield Technical Community College component and seven were upper-division undergraduates matriculating in the University Without Walls component. Fifty percent of the enrolled paraeducators were people of color. In addition, 15 linguistic minorities including Latino and Vietnamese teacher candidates were included in the cohort.

Forty-three percent of STCC's UPDATE Scholars have annual incomes less than $12,000. Thirty-two percent were single parents while 75% indicated they were the first person in their family to attend college. Further, 93% of STCC's UPDATE Scholars were women (Source: Background Question Summary Report; STCC, 1998).

UPDATE Scholars took courses during late afternoon and/or early evening while working in their paraprofessional jobs during the day. This was in addition to keeping up with their family responsibilities, which for some were very demanding.

Methodology

Instruments and Procedures

Between June 1998 and December 1998 UPDATE Scholars periodically completed two questionnaires: the *Revised Teacher Attitudinal Survey* and an *Instructional Strategies Survey*. The original Teacher Attitudinal Survey was designed by Suzanne Chapin of Boston University. In this study the original questionnaire was slightly revised. The revised questionnaire (Appendix A)

contains 44 statements to which students responded on a Likert scale. That is, each item had five possible responses, ranging from "1-strongly agree" to "5-strongly disagree". Student responses to these 44 items were used to compute their scores on four subscales intended to measure their attitudes and beliefs: "Views about Mathematics", "Being Good at Mathematics", "Learning Mathematics" and "Teaching Mathematics".

The *Revised Teacher Attitudinal Survey* was used to see if paraeducators' attitudes and beliefs changed between the beginning and end of each mathematics course, the beginning of Algebra I and the end of Algebra II, and the beginning of Algebra I and the end of Mathematics for Early Childhood/ Elementary Teachers.

The *Instructional Strategies Survey* (Appendix B) contains 15 instructional strategies to which students responded with one of the following five responses: *"Didn't happen", "Happened and not helpful", "Happened and somewhat helpful", "Happened and very helpful", and "Happened and extremely helpful"*. In addition, this survey has several questions designed to gather information about how specific instructional strategies helped paraeducators learn and to determine if the learning in these mathematics courses related to their work as paraeducators. Our survey was adapted from the Rocky Mountain Teacher Education Collaborative (RMTEC) Course Checklist. Paraeducators' responses to this survey were used to determine what instructional strategies were used and whether the instructional strategies used were helpful to their learning of mathematical concepts.

Data Collection

The two survey instruments (*Revised Teacher Attitudinal Survey* and *Instructional Strategies Survey*) as well as focus groups and interviews were used to provide varied perspectives (both quantitative and qualitative) of the program. During Summer and Fall 1998, each mathematics course administered the two survey instruments. The *Revised Teacher Attitudinal*

Survey was administered twice: once during the beginning of the semester, and once near the end of the semester. The *Instructional Strategies Survey* was administered once near the end of the semester. Both surveys were administered in-class to all students present on that particular date.

In addition, a focus group with paraeducators enrolled in the summer mathematics courses was conducted. Thirty UPDATE Scholars participated in the focus group. The purpose of the focus group was to gather information from paraeducators about the overall UPDATE Program and specifically about the summer mathematics courses. Participation in the focus group was voluntary and no members of the Springfield Technical Community College staff were present. The focus group was videotaped for transcription purposes only. The session lasted approximately 75 minutes. In addition, informal interviews were conducted with the professors who taught the three mathematics courses discussed in this study. The purpose of the faculty interviews was to gather information from the professors' perspective.

Results

To find out if there were any differences in UPDATE Scholars' attitudes toward mathematics over time a t-test was used. A one-tailed t-test was used to make comparisons of paraeducators over time because we predicted that students' attitudes toward mathematics would improve after successfully completing mathematics courses. Therefore, our rejection region is located in only one-tail of the distribution. Any p value that is less than .05 is considered statistically significant.

A one-tailed unpaired t-test showed that there was no statistically significant difference in UPDATE Scholars, enrolled in Algebra I (MM 087) during Summer 1998, mathematics attitude mean scores between the beginning and the end of the course (Table 1). Paraeducators' attitudes toward mathematics did not change over the time they were enrolled in Algebra I.

Table 1

UPDATE Scholars' Attitude Toward Mathematics Mean Scores

Course	Semester	pre	post	p-value	df
MM 087	Summer 98	3.37	3.36	.525	38
MM 097	Summer 98	3.38	3.43	.251	34
MM 123	Summer 98	3.45	3.26	.877	10
MM 123	Fall 98	3.50	3.52	.397	30

Similarly, there were no statistically significant differences in UPDATE Scholars, enrolled in both Algebra II (MM 097) and Math for Early Childhood/Elementary Teachers (MM 123) during Summer 1998, mathematics attitude mean scores between the beginning and the end of the course (Table 1). Paraeducators' attitudes toward mathematics did not change over the time they were enrolled in any of the three courses offered during Summer 1998. Additionally, there was no statistically significant difference in UPDATE Scholars, enrolled in Early Childhood/ Elementary Teachers during Fall 1998, mathematics attitude mean scores between the beginning and the end of the semester.

Change Over Time

There was no statistically significant difference ($p = .201$) in UPDATE Scholars mathematics attitude mean scores between the beginning of Algebra I and the end of Algebra II. Paraeducators' attitude toward mathematics did not change over this time period. However, a one-tailed unpaired t-test showed that there was a statistically significant difference ($p = .031$) in UPDATE Scholars mathematics attitude mean scores between pre Summer 1998 Algebra I and post Fall 1998 Math for Early Childhood/Elementary Teachers. The overall

mathematics attitude pre mean score was 3.37 and the post mean score was 3.52. Paraeducators' attitudes toward mathematics become more positive from the beginning of Algebra I to the end of Math for Early Childhood/ Elementary Teachers. UPDATE Scholars who started with very low level mathematics skills and who took two developmental mathematics courses followed by Math for Early Childhood/ Elementary Teachers were the only students who showed a significant improvement in their attitudes toward mathematics over time.

In addition to checking for significant differences between UPDATE Scholars' attitudes toward mathematics at the time of the first survey and their attitudes at the time of the last survey, the data was analyzed graphically to get a qualitative impression of how UPDATE Scholars' attitudes evolved. Figure 1 illustrates that, while there was no significant difference between pre MM 087 and post MM 097 mean scores there appears to be a trend. Paraeducators' attitudes toward mathematics seem to have improved as more courses in mathematics, were taken.

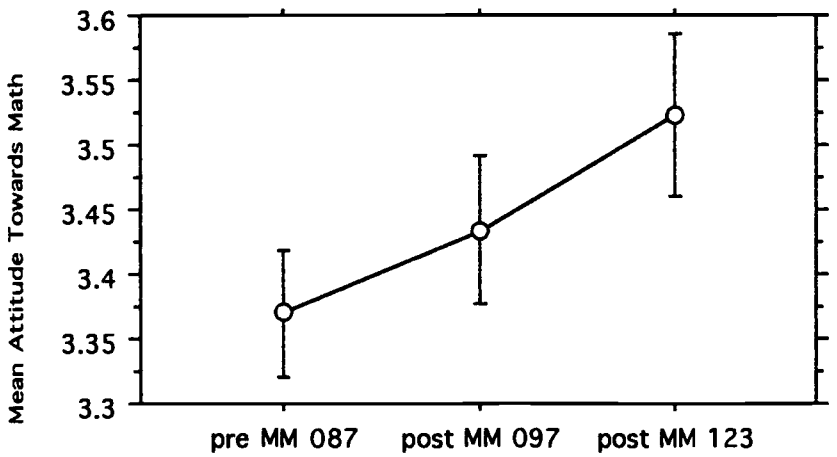

Figure 1. UPDATE Scholars' Attitude Towards Math Mean Scores
Error Bars: ± 1 Standard Error(s)

Figure 2 shows that over the time the three mathematics courses were taught, UPDATE Scholars' attitudes toward mathematics moved in the desired direction for only one of the subscales: *"Views about Mathematics"*. There was no

significant change in UPDATE Scholars' attitudes toward mathematics on the three other subscales: *"Being Good at Mathematics", "Learning Mathematics" and "Teaching Mathematics"*.

It is important to note that the paraeducators enrolled in the above described mathematics courses were meeting general education college content mathematics requirements. They had not yet taken a methods course and had not done their student teaching. Changing the way introductory mathematics courses were taught , i.e., using more constructivist teaching and learning strategies, appears to have a positive impact on UPDATE Scholars' attitudes toward mathematics.

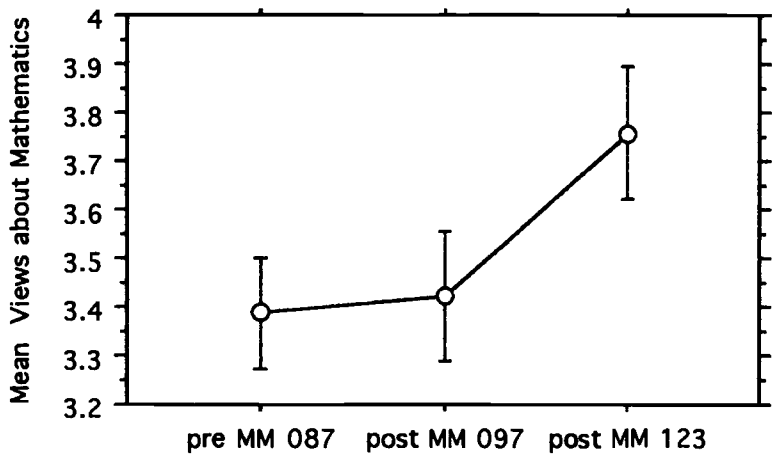

Figure 2. UPDATE Scholars' Views about Mathematics Mean Scores
Error Bars: ± 1 Standard Error(s)

Instructional Strategy Survey

Results from the *Revised Instructional Strategy Survey* (Table 2) indicated that constructivist instructional strategies, such as cooperative learning groups, classroom discussions, and the use of manipulatives, were helpful to paraeducators learning. Overall, the responses on the surveys suggested that the methods used in the three mathematics courses helped the paraeducators

learn mathematics more than they would have had they been enrolled in a more traditionally taught mathematics course.

How did constructivist instructional strategies help paraeducators learn mathematics? The following is a summary of the comments that paraeducators made, on the *Instructional Strategies Survey* and/or in the focus group, about how the instructional methods used helped them learn mathematics:

- Group work allowed them to learn different ways to solve mathematics problems.
- Group work allowed them to help each other.
- Working in groups reduced some of their math anxiety.
- The use of manipulatives and hands-on activities helped them understand math concepts.
- Helping other students learn math helped them learn the material better.
- Students learned how to use different math manipulatives (Cuisenaire rods and pattern blocks) to solve math problems.
- Discussions helped their critical thinking skills.

An added benefit was that the paraeducators understood how important it is to use manipulatives, in the classroom, to help children learn mathematical concepts. This is supported by the interviews with the mathematics professors.

Table 2
Summary of Instructional Survey (N = 45)

Strategy	Didn't happen	Happened and not helpful	Happened and somewhat helpful	Happened and very helpful	Happened and extremely helpful
Cooperative groups (small group work)	0%	4%	11%	42%	42%
Lecture and note taking *2% Blank	0	2	18	47	31
Class discussions	0	4	9	51	36
Supportive atmosphere for learning new ideas	0	2	9	53	36
Use of technology (computers, calculators, etc.)	22	0	24	33	20
Solving problems related to everyday life *4% Blank	44	0	27	11	13
Use of manipulatives and hands-on learning experiences	7	18	31	28	16
Feedback from the instructor about your learning	22	0	24	38	16
Opportunities to demonstrate your understanding in more than one way *2% Blank	18	2	31	31	16
Asked to build on previous knowledge	29	2	27	27	16
Opportunities for you to influence what happened in this course *4% Blank	29	0	29	22	16
Connecting ideas in this course with other content areas *2% Blank	42	4	20	20	11
The opportunity to explore ideas in which you were interested *4% Blank	44	0	20	22	9
Solving problems with complex rather than simple solutions *2% Blank	20	7	27	29	13
A learning environment that demonstrated respect for diversity	11	2	18	33	36

The professors indicated that paraeducators could see the value of using manipulatives with children in the classroom. For example, one professor said:

> In order to help students (paraeducators) understand equivalents the class used Cuisenaire rods and pattern blocks. They found this type of approach to learning and problem solving to be extremely helpful. Using manipulatives helped them really understand the concept of equivalents. They (paraeducators) knew that their students also needed to learn using manipulatives.

In addition, the paraeducators indicated, on the survey, that they found the way the mathematics courses were taught was beneficial to the work they did as paraeducators. The instructional strategies used, in the three mathematics courses, taught the paraeducators that when a child doesn't understand how to solve a mathematics problem, a different approach is needed. The constructivist instructional methods helped in the following ways:

- It helped them broaden their perspectives about working with children.
- It helped them learn how to break down math problems for children.
- They learned that hands-on activities helps some children learn math concepts.
- It helped them understand how to work with children who have difficulty with learning.
- They learned teaching methods they can use in the classroom.
- It gave them more confidence with their math skills and their ability to help students learn math.
- They learned that it is important to have patience when they are trying to help students learn.

Paraeducators indicated they felt that traditional lecture format courses often made them afraid to ask for help when they were confused. Whereas, they felt

that instructors who used a constructivist instructional approach (which we call user-friendly) made UPDATE Scholars feel comfortable asking questions. This was confirmed by the interviews with the mathematics professors. Faculty comments suggested that at the end of the semester paraeducators were more comfortable asking questions.

Conclusion

The series of mathematics courses offered at Springfield Technical Community College through the UPDATE Program, during Summer and Fall 1998, appears to have had a positive impact on paraeducators' attitudes toward mathematics. The data indicates that the instructional methods used in these three mathematics courses helped paraeducators learn mathematics. In addition, the instructional methods used were beneficial to the work that UPDATE Scholars did in the classroom as paraeducators.

Research has shown that prospective teachers' and teachers' attitudes toward and beliefs about mathematics are key influences on how they teach mathematics (Ball, 1990a, 1990b; Moreiri, 1991; Peterson, Fennema, Carpenter & Loef, 1989; Schoenfeld, 1985, 1989; and Silver, 1985). During the period the UPDATE Scholars were surveyed, all were completing their general education mathematics content requirements and had not yet taken pedagogy (methods) courses and had not begun to do their student teaching. While these findings suggest that mathematics courses taught using constructivist methods have an impact on paraeducators' attitudes toward mathematics, it is only the beginning of preparing pre-service teachers to incorporate reform-based practices into their future mathematics teaching. The hope is that UPDATE Scholars' attitudes toward mathematics will positively impact their student teaching, as well as their mathematics teaching in years to come.

As encouraging as the results of this study are, questions remain unanswered. Would the results have been the same if the paraeducators had enrolled in mathematics courses that did not use constructivist instructional

approaches? It is likely that the instructional approaches used by the professors of the three mathematics courses influenced paraeducators' attitudes toward mathematics in some way. Comparison studies of preservice teachers enrolled in traditional mathematics courses would provide insight into the effect generated by the constructivist instructional approaches used in this study. Because paraeducators work in classrooms everyday with children, it is not clear how classroom experiences may have contributed to changes in paraeducators' attitudes toward mathematics. Comparisons of preservice teachers going through the same reformed mathematics courses without classroom experiences might help identify the specific elements of influence that come from experiences in which paraeducators work with children in the elementary classroom. Finally, the question of long-term impact should be discussed. What teaching behaviors will these paraeducators exhibit when they student teach? What behaviors will they exhibit when they have classrooms of their own?

Clearly, this study shows that mathematics courses taught using a constructivist instructional approach had a positive impact on paraeducators' attitudes toward mathematics. The mathematics courses provided paraeducators with opportunities to learn mathematics, while working with children in the classroom provided them with opportunities to apply what they learned to help children learn mathematics.

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APPENDIX A

Revised Teacher Attitudinal Survey

Revised Teacher Attitudinal Survey

You will be asked to fill this survey out at the beginning and the end of this course. Your responses on this survey will be kept strictly confidential and will not affect your grade in this course in any way. Thank you for your participation!

Course Name and Number: _____

What grade level are you interested in teaching? _____

What subject (s) would you like to teach? _____

For each statement below, please indicate your agreement or disagreement by circling the number that best expresses what you think about the statement. Your replies can range from **strongly agree (SA or 1) to strongly disagree (SD or 5).**

I. Your views about mathematics

	Strongly Agree		Not sure		Strongly Disagree
1. Mathematics just isn't my strength and I avoid it whenever possible.	1	2	3	4	5
2. I'm pretty good at mathematics and I enjoy the challenge of it.	1	2	3	4	5
3. I can handle basic mathematics, but I don't have the kind of mind needed to do problem solving.	1	2	3	4	5
4. If I would give it full effort, I know I could learn more mathematics.	1	2	3	4	5
5. Doing mathematics allows room for original thinking and creativity.	1	2	3	4	5
6. A lot of concepts in math must simply be accepted as true and remembered; there aren't explanations for them.	1	2	3	4	5
7. Mathematics is a growing field of knowledge.	1	2	3	4	5

	Strongly Agree		Not sure		Strongly Disagree
8. The content of mathematics has not changed much since I was in elementary school.	1	2	3	4	5
9. Mathematics is needed for most jobs and careers.	1	2	3	4	5
10. To succeed in school, you need to be good in mathematics.	1	2	3	4	5
11. To be a well-educated person, it is important to study major areas of mathematics as it is to read classic literacy works.	1	2	3	4	5
II. Being good at mathematics					
to be good at mathematics, you need to ...					
12. Only remember formulas, principles and procedures.	1	2	3	4	5
13. Always think in a logical step-by-step manner.	1	2	3	4	5
14. Have basic understanding of concepts and strategies.	1	2	3	4	5
15. Be able to think flexibly or creatively.	1	2	3	4	5
16. Have confidence you can do it.	1	2	3	4	5
17. Have a kind of "mathematical mind."	1	2	3	4	5
18. Work hard at it.	1	2	3	4	5
19. Be interested in mathematics.	1	2	3	4	5
III. Learning mathematics					
20. When students can't solve problems, it's usually because they can't remember the right formula.	1	2	3	4	5
21. Students should be given the opportunity to use technology (computers, calculators, etc.) to learn mathematics.	1	2	3	4	5

	Strongly Agree		Not sure		Strongly Disagree
22. If students get into arguments about ideas or procedures in mathematics class, it can impede their learning of mathematics.	1	2	3	4	5
23. In learning mathematics, students must completely master topics and skills at one level before going on to the next level.	1	2	3	4	5
24. Most students need an enormous amount of practice to get better at mathematics.	1	2	3	4	5
25. Students should be given the opportunity to explore mathematical ideas in which they are interested.	1	2	3	4	5
26. It is important for students to be given the opportunity to demonstrate their mathematical understanding in more than one way.	1	2	3	4	5
27. In general, boys tend to be naturally better at mathematics than girls.	1	2	3	4	5
28. Students should be given the opportunity to ask questions in class.	1	2	3	4	5
29. The chance to manipulate concrete objects helps students learn mathematical concepts.	1	2	3	4	5
IV. Teaching mathematics					
30. If a student asks a question in math, the teacher should always know the answer.	1	2	3	4	5
31. Being good at mathematical problem solving personally has little to do with being a good mathematics teacher.	1	2	3	4	5
32. Understanding mathematics as a discipline is important for teaching mathematics at any level.	1	2	3	4	5
33. In order to teach problem solving, teachers have to do a lot of mathematical problem solving themselves.	1	2	3	4	5

	Strongly Agree		Not sure		Strongly Disagree
34. It is important for teachers to know appropriate mathematical terminology.	1	2	3	4	5
35. Basic computational skill and a lot of patience are sufficient for teaching elementary school mathematics.	1	2	3	4	5
36. Students should never leave mathematics class feeling confused or stuck.	1	2	3	4	5
37. It is more important to answer students' questions than to let them puzzle things out themselves.	1	2	3	4	5
38. If students are having difficulty in mathematics, a good approach is to give them more practice in the skills they lack.	1	2	3	4	5
39. If a students is confused in mathematics, the teacher should go over the material again more slowly.	1	2	3	4	5
40. The most important issue is not whether the answer to any mathematics problem is correct, but whether students can explain their answers.	1	2	3	4	5
41. The range of ability in most classes makes whole group teaching in mathematics virtually impossible.	1	2	3	4	5
42. It is a not a good idea to have students work together in solving problems because the brighter student will do all the work.	1	2	3	4	5
43. Because every student is different, it's always best to let students work on their own.	1	2	3	4	5
44. Manipulatives must be used in a lesson in order for it to be a "good" lesson.	1	2	3	4	5

APPENDIX B

Instructional Strategies Survey

Instructional Strategies Survey

Your responses on this survey will be anonymous and will not affect your grade in this course in any way. Thanks you for your feedback!

Part I: INSTRUCTIONAL STRATEGIES THAT HELPED YOU TO LEARN.

The following items represent dimensions of instruction that might have been implemented in your course. If particular instructional activities were not implemented, please check " Didn't happen". If they were implemented, please indicate the degree to which the strategies were helpful to you in learning course concepts and content. Please check one response for each item.

Strategy	Didn't happen	Happened and not helpful	Happened and somewhat helpful	Happened and very helpful	Happened and extremely helpful
Cooperative groups (small group work)					
Lecture and note taking					
Class discussions					
Supportive atmosphere for learning new ideas					
Use of technology (computers, calculators, etc.)					
Solving problems related to everyday life					
Use of manipulatives and hands-on learning experiences					
Feedback from the instructor about your learning					
Opportunities to demonstrate your understanding in more than one way					
Asked to build on previous knowledge					
Opportunities for you to influence what happened in this course					
Connecting ideas in this course with other content areas					

Strategy	Didn't happen	Happened and not helpful	Happened and somewhat helpful	Happened and very helpful	Happened and extremely helpful
The opportunity to explore ideas in which you were interested					
Solving problems with complex rather than simple solutions					
A learning environment that demonstrated respect for diversity					

Part II: Additional Comments.

1. Has the method of teaching in this class been beneficial to your learning of the course material? If so, please explain how.

2. Please list two or three things that you learned in this class that you think you might not have learned had this class been taught strictly in a traditional lecture format.

3. Have you applied any instructional methods or activities used in this course in any K12 classrooms? _____

   If you answered yes please describe the following:

   a) What methods or activities have you tried?
   b) Where and with whom did you try using these methods or activities?
   c) How did these methods or activities work?

4. How does what your learning in STCC courses relate to the work you do as a paraprofessional?

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